Impact Report

Missouri Improving Teacher Quality Grant Program - Cycle 9 - Program Evaluation

Summary

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MDHE
Missouri Department of Higher Education
Building Missouri's future... by degrees

M.A. HENRY CONSULTING, LLC

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1. Introduction

Did the Missouri Department of Higher Education's Improving Teacher Quality Grant Program (ITQG) achieve its intended impact in mathematics and science among teachers and students in Cycle 9?

Do teacher content knowledge and teaching skills improve because of participation in an ITQG professional development project?

Do students achieve better outcomes in science and mathematics as a result of their teachers' participation in an ITQG project?

What are the larger effects of the program? Do the seven current ITQG projects affect the way universities and school districts do their work in relevant areas, such as teacher preservice education? Is there a lasting change among the organizations participating in the ITQG?

Did the funded projects conduct themselves as they intended when they were funded?

And what does this all mean for Missouri's students, in the long run?

These are the major questions driving the external evaluation of the ITQG, conducted by M.A. Henry Consulting, LLC in the ninth funding cycle of the program. Applying refined evaluative methods, the new evaluators have sought to support the efforts of the Missouri Department of Higher Education – the grant funder through U.S. Department of Education funding sources – to enhance the ability to address impact questions about the ITQG.

This summary serves as the general report of the ITQG evaluation. A more detailed technical summative report is available as well, which provides additional information about results from the ITQG program's ninth cycle.

Representing a change in approach for the program's evaluation, and with an intention to raise the Department of Higher Education standards for projects in their implementation and internal assessments, the ninth cycle was a period of transition for project teams accustomed to earlier methods and practices. The nation and state are passing through a time when federal and local funding for such teacher professional development efforts is increasingly scarce. A more rigorous attention to efficacy and effects serves both to maximize the impact of the funded work and substantiate the grant program's value.

At the same time, teacher professional development is not a controlled experiment and education evaluation is not laboratory work. It occurs in the field, in the real world, in the context of the complex dynamics operating around such professional development projects. Both quantitative and qualitative methods are applied, with evaluative results representing the best possible under the individual circumstances presenting in the various projects. But for the first time with the ITQG, an objective sense of impact is available.

The impact of the Improving Teacher Quality Grant Program can be expressed in several ways. Easiest to compile and share is information on how ITQG's Cycle 9 compared with the program's earlier experience in terms of numbers, such as numbers of projects, teachers, school districts and students participating and served. More challenging are statements about impact and meaning: What did the projects actually achieve for all the funding, effort and engagement that went into it? After all, the mere fact that people are coming together for professional development does not inevitably mean that teachers and students are benefiting, or taking away what was intended.

Because the ITQG program involves disparate projects working in a variety of math and science content areas across all grades Kindergarten through 12th, and is being implemented by projects running from one to three years, developing an integrated approach to measuring and analyzing program impact is daunting. However, this report presents background information on the ITQG's Ninth Cycle for contextual purposes, and then shows results for each of the program's five major objectives.

The evaluators appreciate the cooperation and commitment experienced with the scores of teachers, project faculty, staff members, colleagues at the Missouri Department of Elementary and Secondary Education and the Missouri Department of Higher Education, and others who have contributed to this effort to enhance mathematics and science learning in Missouri.

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2. ITQG Cycle 9 Profile

The Missouri Department of Higher Education's Improving Teacher Quality Grant Program – Cycle 9 comprised seven science or math teacher professional development projects led by universities/colleges or regional professional development centers, covering schools and school districts reaching most regions of Missouri.

Cycle 9 Projects and Their Schools and Districts

As Figure 1 shows, schools reached by the seven projects generally were clustered by sub-regions around the lead university or college's location, the exception being the University of Missouri's project, which drew from a more broad area across the state. Schools came from 64 public school districts plus 5 parochial/private schools and 1 charter school. Table 1 provides additional background information about each project in Cycle 9. Thirty-four percent (22) of the public school districts were high-need.

Figure 1. Location of Schools in ITQG – Cycle 9 by Project (some locations have >1 school)

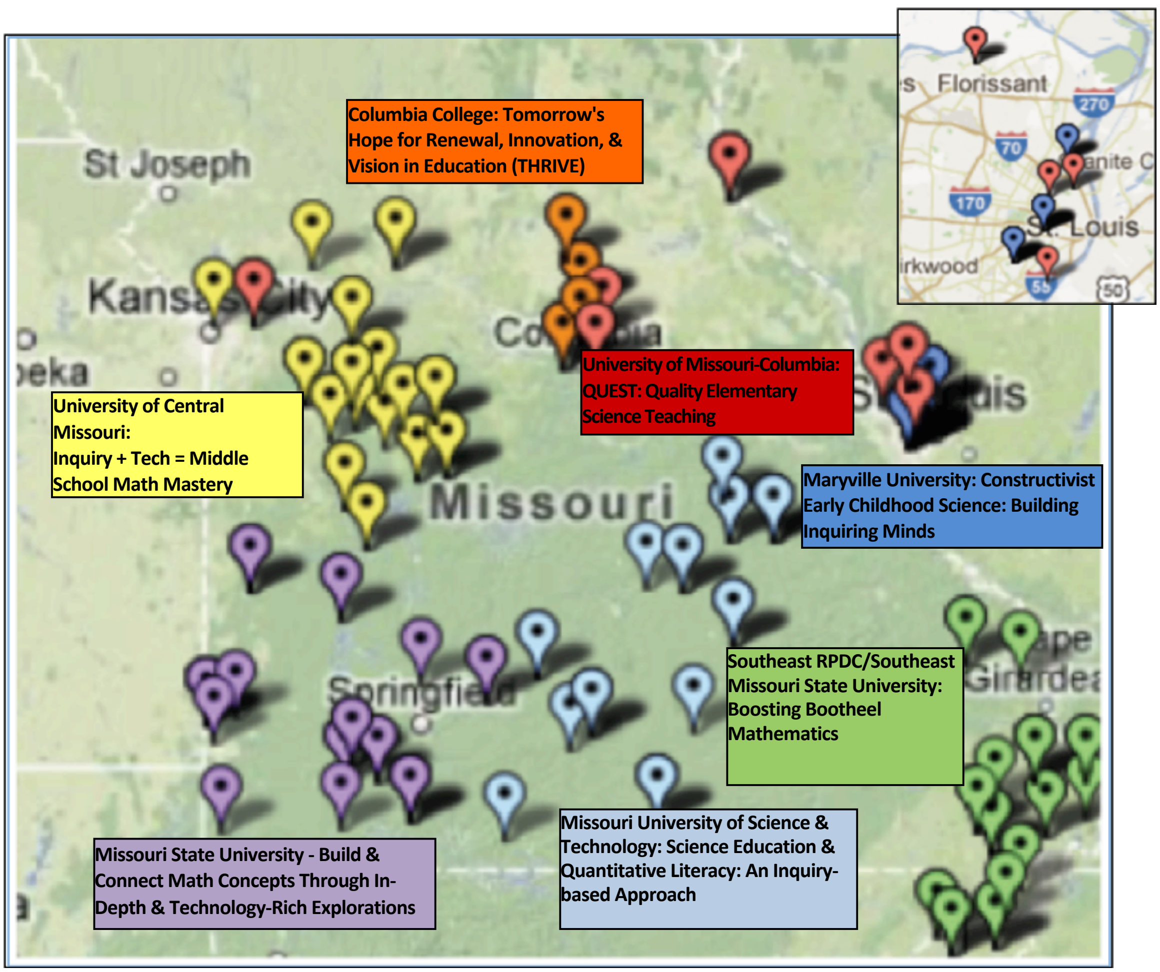
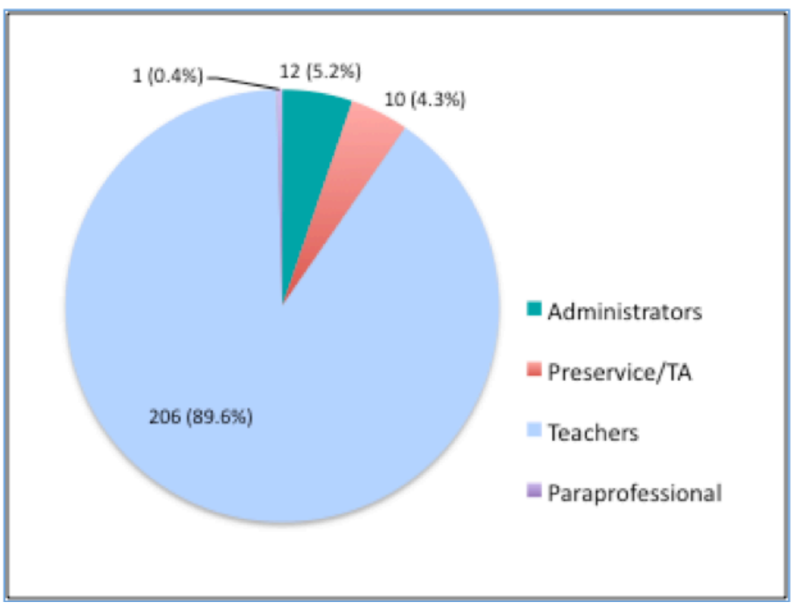


Table 1. ITQG Cycle 9 Projects

Lead Institution	Project Title	Grade Levels	Focus	Years	Primary Region	Teacher Participants	Other Participants
Columbia College	THRIVE: Tomorrow's Hope for Renewal, Innovation, & Vision in Education	K-6	Math & Science	1 of 1	Central	10	0
Maryville University	Constructivist Early Childhood Science: Building Inquiring Minds	K-3	Science	1 of 2	St. Louis	37	3
Missouri State University	Build & Connect Math Concepts Through In-Depth & Technology-Rich Explorations	9-12	Math	2 of 2	Southwest	28	0
Missouri University of Science & Technology	Science Education & Quantitative Literacy: An Inquiry-based Approach	5, 6, 7	Math & Science	1 of 3	South Central	40	0
Southeast Missouri State University (Southeast RPDC)	Boosting Bootheel Mathematics	4-8	Math	3 of 3	Southeast	32	0
University of Central Missouri	Inquiry + Tech = Middle School Math Mastery	6-12	Math	1 of 1	West-Central & Kansas City	30	0
University of Missouri - Columbia	QUEST: Quality Elementary Science Teaching	K-6	Science	1 of 3	Central, St. Louis, & Northeast	29	15

Individual projects covered math and/or science content areas across a range of grade levels. Projects new to the ITQG in Cycle 9 were to meaningfully incorporate environmental education into their curriculum. Also, all projects were to involve a minimum of 20 teacher participants, with at least half coming from high-need school districts. All projects attained or nearly attained the latter criterion, as attrition affected some final counts. One project experienced its committed partner school district's backing out at the last minute, and was accepted as a one-year pilot project. Across the entire ITQG program, 72% of teachers were from high-need public school districts.

Figure 2. Numbers and Types of Participants in ITQG Cycle 9



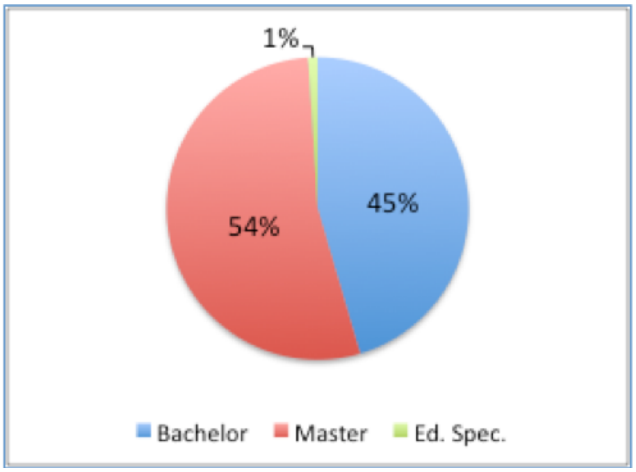
Who Participated?

A total of 229 participants engaged in Cycle 9. The largest proportion, 206 (90%), were teachers. Twelve administrators, 10 preservice teachers/TA participants, and 1 paraprofessional made up the other 10%. The number of teachers has ranged from 155 to 369 in previous cycles.

Teacher Characteristics

Among teachers reporting these data in Cycle 9, teachers averaged 11 years of teaching experience. They therefore represented an experienced group of educators overall. Slightly more than half (54%) of those reporting educational attainment had master's level degrees. Figure 3 shows the distribution of teachers' levels of education.

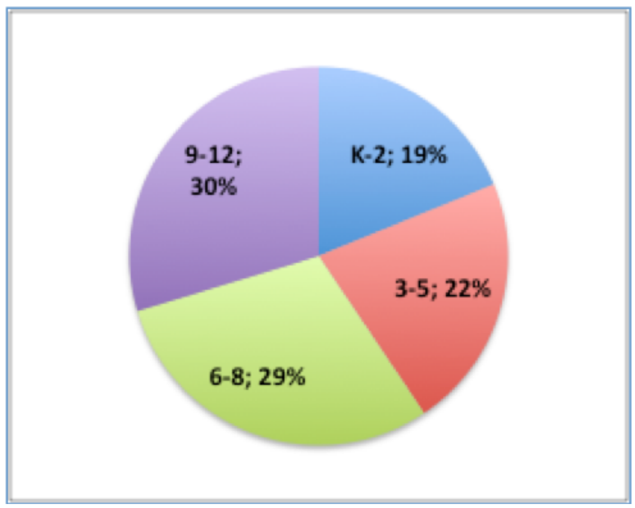
Figure 3. Teachers' Educational Attainment in ITQG Cycle 9 (reported n=204)



The grade levels taught by Cycle 9 teachers were well distributed. Many teachers taught at more than one grade level. For example, high school level math and science teachers very often taught more than one grade, as did middle school teachers.

As Figure 4 indicates, when all grades taught by teachers were considered, a near-even spread was seen with early grades K through 2, elementary grades 3 through 5, middle school grades 6 through 8, and high school grades 9 through 12. Individual schools and school districts at times use junior high school or other organizations of grade clustering, but the effect is the same: ITQG Cycle 9 projects, considered together, reached the full range of grades targeted by the program.

Figure 4. Percent of Teachers Teaching at Various Grade Levels in ITQG Cycle 9

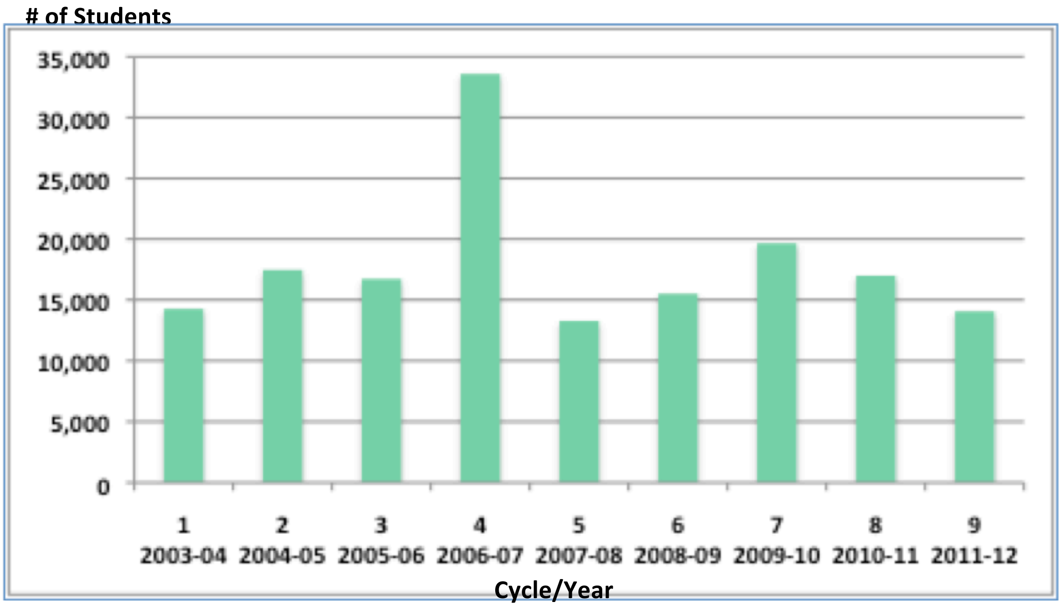


Students Affected by Cycle 9 Projects

The number of students directly affected by the ITQG in Cycle 9 totaled 14,083, based on reports of classroom data from teachers. Teachers taught an average of 68 students each in Cycle 9, with a wide range of student counts among individual teachers, depending on such factors as content focus and grade level.

Figure 5 compares Cycle 9's student counts with those reported in previous cycles. Numbers of students were affected by such factors as funding level, number of projects and, to some extent, grade level, as high school teachers often teach more students than do teachers at earlier grade levels. The sudden increase in students in Cycle 4 represented a one-time targeted effort at expanded project numbers and teacher recruitment, aiming at larger numbers of grants with smaller total budgets.

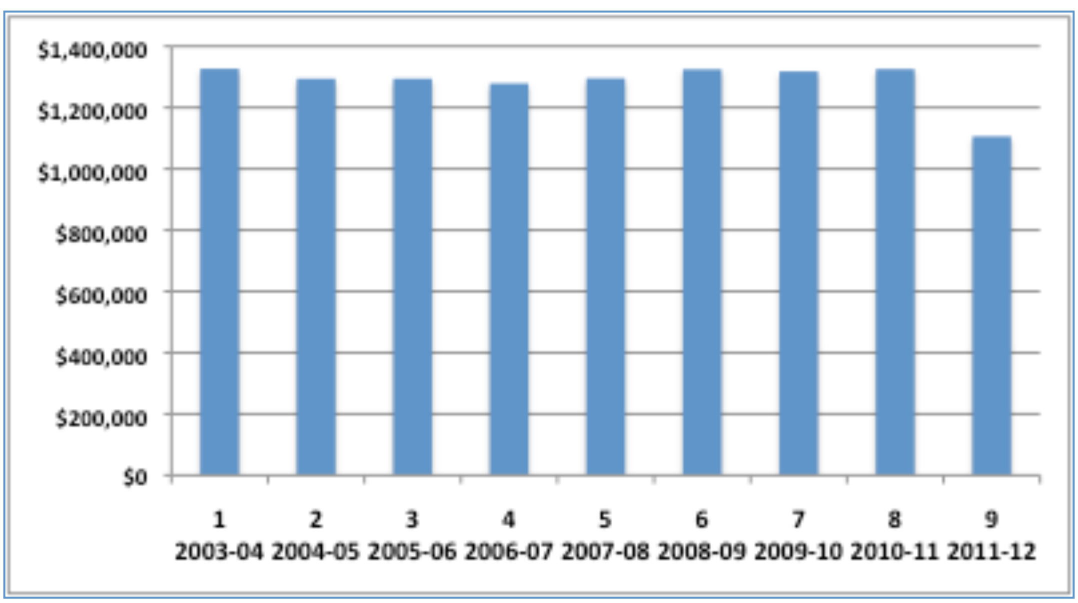
Figure 5. Number of Missouri Students Reported to Be Directly Affected by ITQG, by Cycle



Costs per Teacher and Student

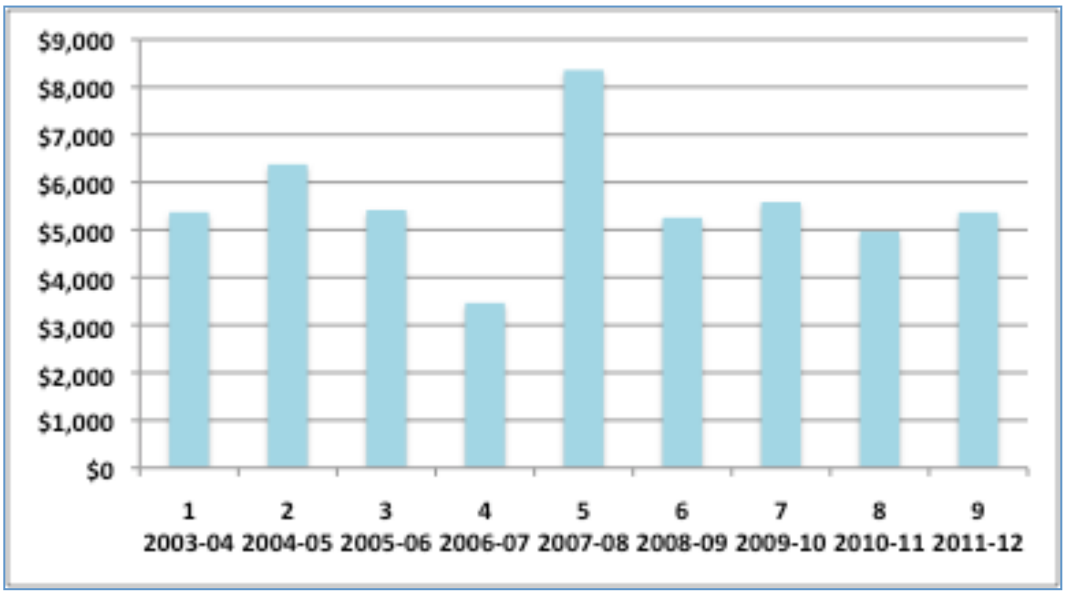
An additional way to consider how Cycle 9 compared to past ITQG experience may be seen in comparing funding and mean cost per teacher and affected students. Figure 6 presents total ITQG Program funding granted to Missouri projects through the Federal Title II, Part A Improving Teacher Quality Grant program, operating under the No Child Left Behind (NCLB) Act of 2001 (CFDA 84.367). As can be seen, the $1,106,200 available in Cycle 9 was the least of all cycles.

Figure 6. Federal Funding for Missouri's ITQG Program Across Cycles



Calculating cost by participating teacher offers a better comparison across cycles on how funding for all the diversely budgeted projects in the program compare. This statistic does not assess the specific dollars offered as stipends to participating teachers, or other spending details. Rather, the mean cost per teacher displays how differing funding levels and recruitment levels contrast. As can be seen, the mean cost per teacher of $5,370 in Cycle 9 represents the fourth year of relatively stable results, as a balance has been struck between federal funding, number of projects, teachers recruited per project and, inferentially, the grade-spread of teachers reached by the program. The mean cost per teacher for Cycles 1 through 8 was $5,600, further indicating Cycle 9's representative standing.

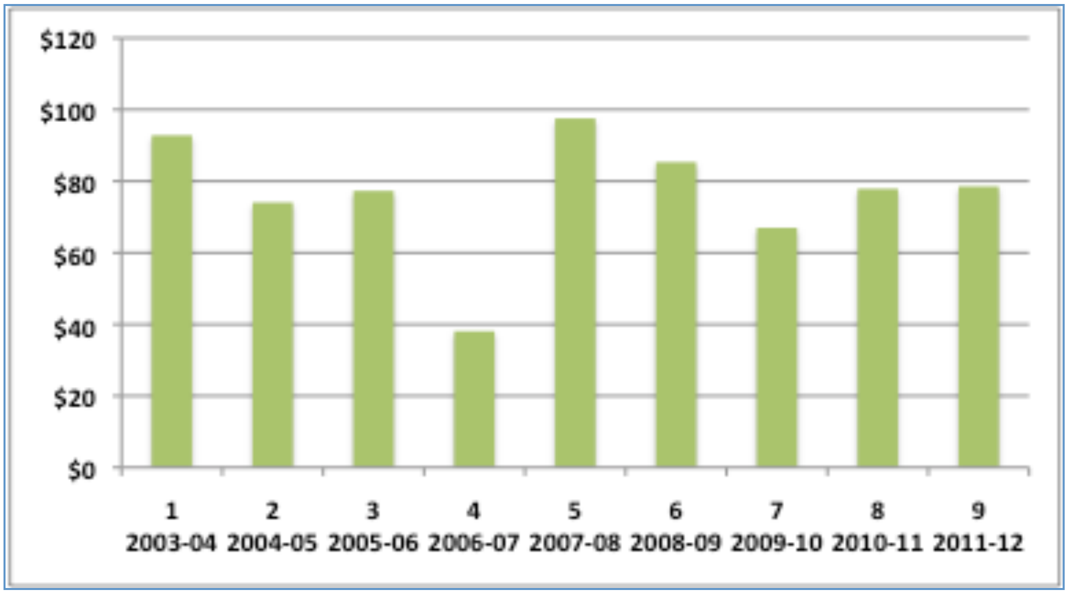
Figure 7. Mean Cost of ITQG per Teacher Across Cycles (Total Budget Divided by # of Teacher Participants)



An additional method of considering comparative value of the Cycle 9 experience is to consider the mean cost per student, by averaging the budget by the total number of students directly affected (taught by participating teachers) in each cycle. Figure 8 presents these data.

Greater values indicate years in which fewer students and larger funding combined to drive up mean "costs per student." Lower values represent years with greater numbers of students compared to relatively lower funding levels. As can be seen, as with Figure 7, experience in the last four cycles indicate a balance being found among the various components of available funding and projects' reach into schools and school districts. The mean cost per student in Cycle 9 of $79 compared to $78 in Cycle 8 and $76 as an average for Cycles 1 through 8 combined.

Figure 8. Mean Cost of ITQG per Student Across Cycles (Total Budget Divided by # of Affected Students)



Formative and Process Evaluation Comments

As has been noted, the ITQG Cycle 9 represented a change in direction for evaluation practice for the program, both in terms of MDHE's expectations on internal evaluation coverage by the projects and for external evaluation. The latter covers a program-wide consideration of implementation alignment and summative results, seeking to ensure that projects are conducting their work as planned so that their intended impact can be maximized (given that professional development designs proved efficacious). The transition was handled well in almost all cases.

As this section of the report has shown, Cycle 9 in most regards fits within the historical patterns already set for the ITQG in terms of scope of reach, project characteristics, school/school districts, participants and students. As the aim of the external evaluation described in this report is to consider program-wide matters, most project-specific details have been placed in the technical section of the final report. However, as detailed in an earlier formative report and noted in numerous other reports to MDHE over the course of the cycle, Cycle 9 saw the implementation of a diverse set of well-designed, well-conducted professional development by teams of seasoned, committed professionals. Teacher satisfaction, cited in scores of individual encounters, was high.

The balance of this report will consider the available evidence concerning the impact of these efforts for the ITQG Program as a whole in Cycle 9, of most immediate concern to the people of Missouri. Each major objective is considered and, as succinctly as possible, evaluated for summative results after a year's professional development intervention.

3. The Impact of Missouri's ITQG Program: Goals and Objectives

ITQG's Impact: What It Strives for and How It Seeks to Accomplish It

The purpose of the Improving Teacher Quality Grant program is to increase the academic achievement of students by helping schools and districts improve K-12 teacher and principal quality and helping to ensure that all K-12 teachers are highly qualified. Through originating and sustaining budgetary legislation, the Missouri Department of Higher Education receives funds on a formula basis to administer to granted projects.

Elementary, middle school and high school teachers teaching science or mathematics have been targeted for participation in various ways over time. Usually, professional development has been focused in an intensive summer session, with academic-year follow-up sessions totaling a minimum of 120 hours. Projects have been one-, two-, or three-year enterprises. Some cycles have identified specific school districts for funding.

Table 2. Improving Teacher Quality Grant Program Objectives Cycle 9

Objective 1: *Improve student achievement in targeted mathematics and/or science content areas.*

Objective 2: *Increase teachers' knowledge and understanding of key concepts in targeted mathematics and/or science content areas.*

Objective 3: *Improve teachers' pedagogical knowledge and practices that utilize scientifically-based research findings and best practices in inquiry-based instruction.*

Objective 4: *Improve teachers' knowledge and skills in designing and implementing assessment tools and use of assessment data to monitor the effectiveness of their instruction.*

Objective 5: *Improve the preparation of pre-service teachers through improvements in mathematics and/or science content and/or pedagogy courses.*

Projects are to represent multi-institution partnerships led by university content and education faculty and including high-need and other school districts, STEM business representatives, other educational and community organizations. In addition to public school districts, charter school and non-public/private schools are included. School administrators and other staff may be included. Pre-service teacher students also have a role in the program, with an ITQG objective to improve pedagogy and science and mathematics courses in teacher preparation programs and other higher education courses.

ITQG Program Goals, Objectives, and Schema for Success

The underlying aims and objectives of the ITQG in Cycle 9 were unchanged from previous years: Improve teacher knowledge of mathematics and/or science content and their pedagogical knowledge and practice, and thereby improve student achievement in these subjects. Also, improve teacher assessment skills so they can better understand their students' needs. Finally, for the universities leading the projects, extend better practice into the schools' pre-service teaching programs and STEM content courses, to aid students preparing to enter the teaching profession. Table 2 on the preceding page shows the specific language of the ITQG objectives.

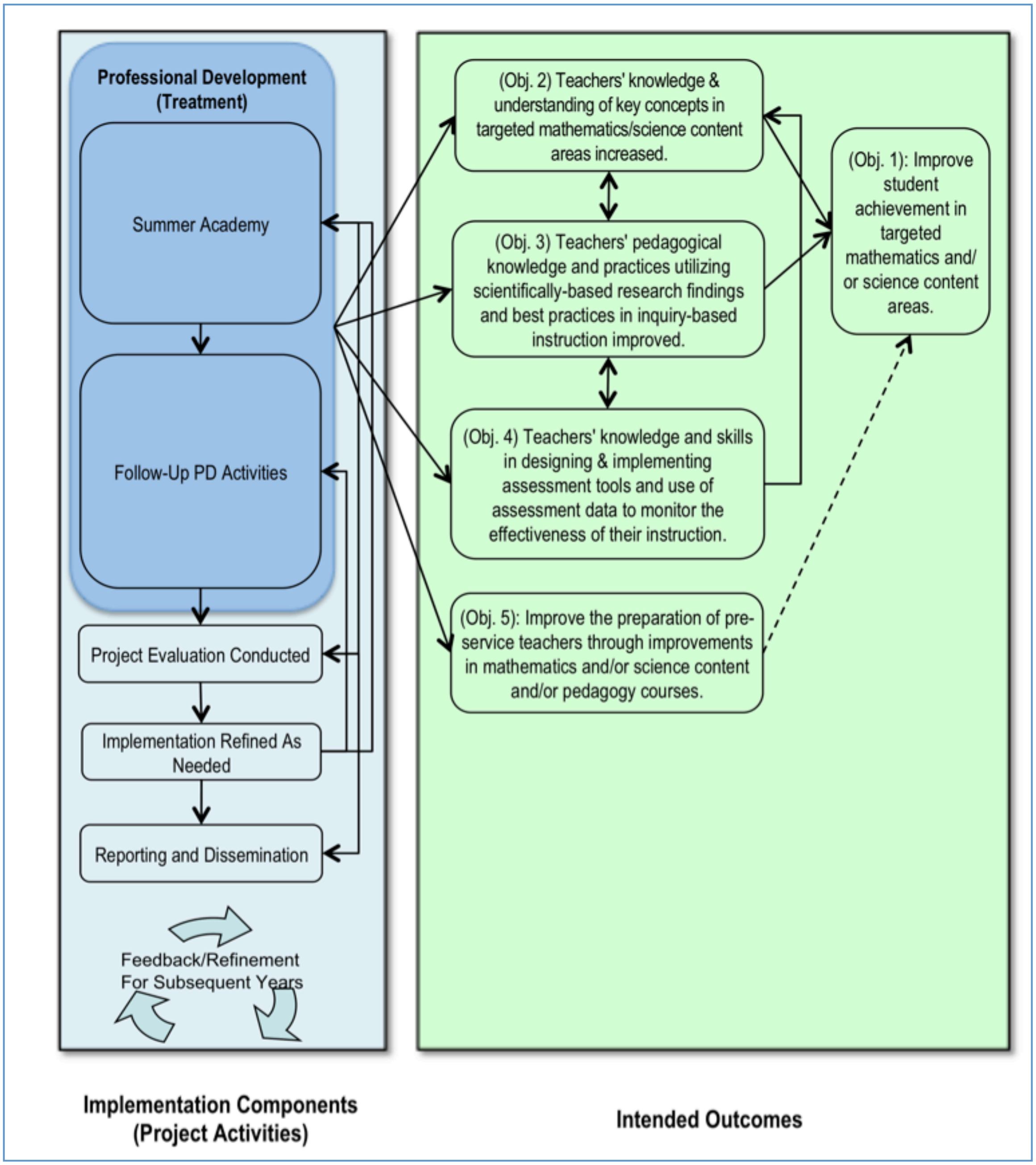
Figure 9 depicts in greater detail the optimal flow envisioned in the ITQG Program Theory, from implementation of sound professional development aligned with project objectives and practices through achievement of intended effects among teachers, students, and participating institutions.

Projects' professional development, in intense summer sessions, follow-up sessions and other contacts, seeks to improve teachers' content knowledge, classroom practice and use of data and assessment tools. Lesson enhancement, resources and support networks combine to support teachers in improving performance. ITQG's vision of exemplary pedagogical practice is grounded in inquiry-based instruction, with emphasis on modeling and meaningful activities in math and science that promote students' learning and are integrated within individual schools and school districts' curriculum, Show-Me Standards, Grade-Level and Course-Level Expectations, Model Core Teaching Standards and North American Association for Environmental Education standards. Environmental education and/or data systems competency also were components of some projects' work in Cycle 9.

All this work with teachers is intended to improve the achievement of their students. Students, of course, are envisioned as the ultimate beneficiaries of all ITQG activities.

Finally, an objective exists to improve the preparation of pre-service teachers by applying the same content and pedagogy strategies in the courses offered at the ITQG institutions of higher education.

Figure 9. ITQG Program Theory (Flow from Activities to Outcomes)



4. ITQG's Impact on Teachers

Teachers' Significant Gains in Content Knowledge

Teachers on a program level showed statistically significant gains in content knowledge acquisition as a consequence of their participation in the ITQG's Cycle 9 based on the results of pre/post testing delivered by the external evaluators. Teachers in each project made some gains on the test, which framed mathematics and science content in a problem-solving framework grounded in an environmental education context.

Testing teachers program-wide was daunting. Projects comprised a complicated math/science content mix. Teachers taught at an extremely broad range of grade levels and had a diverse variety of teaching focuses. Their own educational backgrounds were diverse; the needs for math at the Kindergarten level are a world away from those of a high school math teacher teaching calculus. Also, two projects entered Cycle 9 as ongoing projects, and therefore had no environmental education component in their professional development curriculum.

The evaluators constructed a test with content relevant in some way to most of the range of math and science coursework teachers were teaching. By framing the content in a problem-solving scheme, the test aimed at assessing change in teachers' approach to thinking through content-related questions, which would be an outgrowth of the pedagogical practice to be exemplified by the projects. The test underwent construct and content validity testing with a team of authorities, followed by reliability analyses and convergent validity testing. A Cronbach's coefficient alpha of .77 on the pretest and .82 on the posttest indicated that the items were correlated and tended to be measuring the same construct at a level sufficient for research purposes.

These content tests were delivered at the start of the Cycle 9 summer academy and again in the following spring during projects' follow-up sessions or at a time convenient for teachers when projects did not provide testing time. Analyses on gains yielded the results seen in Table 3 and Figure 10. For the 152 teachers taking both the pretest and posttest, significant gains in content knowledge, as measured by the test, were seen. The mean gain for teachers was 12.2 percentage points.

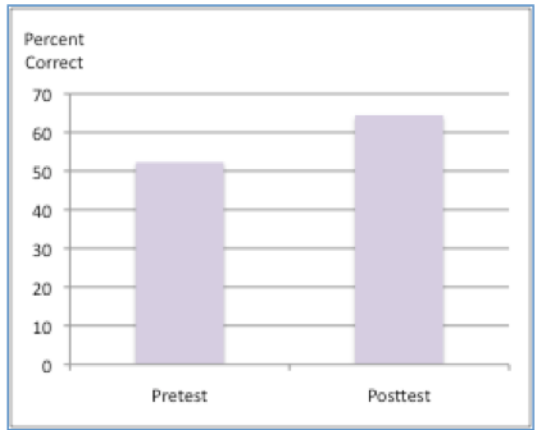
Table 3. ITQG Cycle 9 Teacher Content Test Results (N=152)

Cohort	N	Mean Pretest	Mean Posttest	Mean Difference	*sd*	*t*	Sig (2-tailed)	Effect Size
Total	152	52.27	64.47	12.20	18.88	8	.000*	0.65

$p < .05$

Important to consider is that the test was not a simple assessment requiring teachers to reflect back specific information they had garnered from their experience in the projects. The content, including both math and science, incorporated material considered appropriate for an adult learner and relevant to the types of information covered in Missouri classrooms. Also, the gains seen, being posed in problem solving terms, indicate that ITQG teachers, in the relatively short time of the program's cycle, had increased their ability to "figure things out," a crucial feature of the ITQG pedagogical model.

Figure 10. ITQG Cycle 9 Teacher Pretest and Posttest Scores



Content knowledge gains were statistically significant to a high degree. The effect size shown in the table, a measure of the strength of the relationship, was .65 standard deviation units. An effect size of .25 is considered non-trivial, so the strength of the effect was large.

As noted, since environmental education was included in only those projects that were new to Cycle 9 two projects did not include an environmental education component. This situation permitted a comparison of the two groups to see if the fact that the test focused on environmental education concerns while covering math and science content had an effect on the test results. Table 4 separates tests results between these two groups.

As the table shows, both groups experienced comparable statistically significant gains in content knowledge, as measured by the test. In fact, the comparison group – the teachers in projects not including environmental education, showed greater gains and a much higher effect size. The environmental education context of the test therefore was not off-putting to these teachers.

Table 4. Comparison of ITQG Cycle 9 Teacher Content Test Results between Projects with Environmental Education Component and Projects Without It (N=152)

Cohort	N	Mean Pretest	Mean Posttest	Mean Difference	*sd*	*t*	Sig (2-tailed)	Effect Size
Intervention (Environmental Education)	102	52.23	62.70	10.50	19.7	5.4	.000*	0.53
Comparison (No Environmental Education)	50	52.33	68.08	15.75	17.7	6.7	.000*	0.94

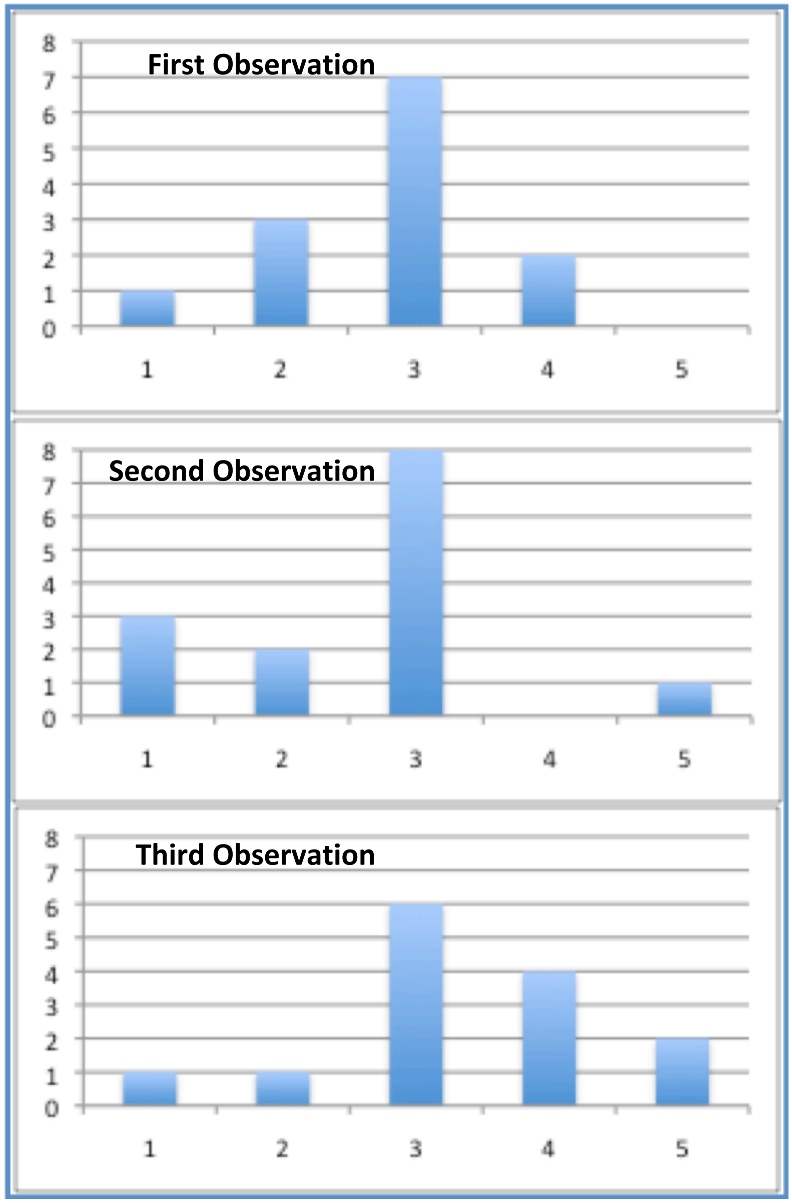
$p < .05$

Addressing changes in classroom practice among participating teachers also presented challenges. Relying on teachers' impressions of their own classroom practice changes lacks objectivity and easily can introduce bias. Not all project teams observe in classrooms, and their focuses and approaches in doing so are not the same as those of external evaluators. Also, relying on projects' data would lack standardization. Resources were not available for the costly and time-intensive task of observing all teachers at their work. The evaluators therefore decided to work with a group of "focus teachers," two per project, who were selected based on their comprising a fair representation of the entire teacher group in terms of experience, school setting, content focus and grade level.

These teachers were observed (ideally) in their classrooms three times during the school year. The *Inside the Classroom Observation and Analytic Protocol* (ITC) (Horizon Research, Inc., 2002) was used.

The ITC observation tool is divided into four domains: design, implementation, mathematics or science content, classroom culture. Each domain has numerous items that are coded according to a 1 through 5 ("not at all" to "a great extent") schema, and a "synthesis rating" is applied to each domain. Finally, a capsule rating with a different coding system but also with scores of 1 through 5 (again, lowest to highest) is used to rate the lesson overall.

Figure 11. Capsule Ratings of Classroom Observations for ITQG Cycle 9 (N=14 teachers, 41 total lesson observed)



Ratings: 1=ineffective instruction, 2=elements of effective instruction, 3=beginning stages of effective instruction, 4=accomplished, effective instruction, 5=exemplary instruction.

Evaluators observed a total of 41 focus teacher lessons in Cycle 9. Combined, they had 270 unique students in the observed lessons. A wide variety of lesson types were observed, from open-ended inquiry with student experiments to semi-directed group activities to directed inquiry with guided activities, to question-and-answer sessions, content reviews, and lecture-based instruction.

As Figure 11 on the preceding page indicates teachers generally improved in capsule ratings for the lessons observed over the course of the school year. Second-observation scores dipped a bit, but a clearer differentiation can be seen between scores for the final observations and those preceding them, with a greater number of teachers rating 4 (accomplished, effective instruction) or even 5 (exemplary instruction).

Table 5 compares scores in individual domains for the three sets of observations. As can be seen, the strongest area throughout was classroom culture. Ratings for all domains were higher by the third observation. Not all teachers evidenced positive movement in scores, but most showed improvements. It should be noted that these domains all contain items dealing with pedagogical practice, including that for content. Focus teachers remaining in Cycle 10 are continuing to be observed.

Table 5. Ratings for Lesson Domains from ITQG Cycle 9 Classroom Observations (N=14 teachers, 41 total lessons observed)

	# of Observations Receiving Score				
Rating	**1**	**2**	**3**	**4**	**5**
First Observation					
Design	1	2	7	3	0
Implementation	1	3	5	4	0
Math/Science Content	0	3	9	1	0
Culture	1	3	4	5	0
Capsule	**1**	**3**	**7**	**2**	**0**
Second Observation					
Design	2	4	6	1	1
Implementation	1	4	7	2	0
Math/Science Content	0	4	8	2	0
Culture	2	3	7	1	1
Capsule	**3**	**2**	**8**	**0**	**1**
Third Observation					
Design	1	1	4	7	1
Implementation	1	2	4	3	4
Math/Science Content	1	0	7	4	2
Culture	2	0	3	6	3
Capsule	**1**	**1**	**6**	**4**	**2**

The Challenge of Systematically Incorporating Assessment Data

All projects in the ITQG Program shared an objective to improve teachers' knowledge and skills in designing and implementing assessment tools and use of assessment data to monitor the effectiveness of their instruction (ITQG Cycle 9 Proposals). Projects attempted to address this objective in various ways. Most projects discussed the development of student assessment items with teachers during the summer. Designs ranged from informal, whole-group discussions on the best questions to use to assess content just covered to more formal methods involving allotting specific times during the summer to develop cross-grade level assessment questions. Some projects involved the Regional Professional Development Center staff in delivering their Data Team training during one day of the summer academy. This training focuses primarily on how to set up and run a team rather than addressing the use of student assessment data to inform instruction.

The strongest example of incorporating student data into instruction was in the project focusing on only one district. This project's teachers and administrators were observed working for extended periods to coordinate student district test data as well as MAP data where available, both vertically and horizontally across grades. Discussions incorporated ways to spiral curricula to assure weaknesses were addressed as students progressed through the grades.

Formative assessment was a common discussion among summer groups as assessment was being considered. During teacher observations, evaluators saw some evidence of formative and ongoing student assessment incorporated into instruction. One teacher worked students through the processes of self-assessment of their own mistakes on a previously taken test. Though students complained, it was clear at the end of the class that, through self-analysis, they had a deeper understanding of the concept, and they expressed as much. This was a unique experience during observations. Other teachers used various strategies to allow students to provide on-time feedback on understanding and some teachers solicited student written comments at the end of the day on what was and was not learned that day along with continuing questions. For the most part teachers incorporated few assessment opportunities into their instruction during the observations.

During interviews teachers expressed an awareness of the need for formative and varied forms of student assessment. Formative assessment, including well thought out and analyzed classroom tests, as well as the best ways to utilize the data from these assessment methods, is an area where continued growth could occur among teachers. Project leadership could incorporate gathering and use of student data in a more systematic way to better meet this objective.

5. ITQG's Impact on Students

The external evaluators sought to improve the ITQG's understanding of impact on students by introducing an analysis plan based on standardized test scores from the Missouri Assessment Program (MAP) and End-of-Course Assessment (EOC) for students of intervention teachers and a comparison group cohort, and applying a refined difference-in-difference (Diff-in-Diff) analysis plan. This approach theoretically would remove the hazards of relying on teacher self-reports of student change as an effect of their being in an ITQG project, or a mix of other disparate project data.

The vagaries of data availability (MAP data for math available Grades 3-8, for science Grades 5 and 8; EOC data available for high school levels) and complexity of issues concerning data quality and completeness challenge the attempt to thoroughly investigate the impact of student achievement using extant data. However, the comprehensiveness of the available data and its applicability to almost all schools, teachers and students touched by the ITGQ made the analysis plan seem worthwhile. The support and cooperation of Missouri Department of Elementary and Secondary Education staff, in complement with staff at the Missouri Department of Higher Education, also contributed to the potential of the plan.

Using matching techniques and Diff-in-Diff methods, a comparison group was constructed to identify the causal effect of the program on the academic performance of the students taught by the ITQG teachers. To perform the impact evaluation analysis, the measurable outcomes of interest were the students' results in the standardized evaluations in mathematics and sciences at two different stages: Elementary/Middle grades (MAP) and High School grades (EOC).

High school students taught by ITQG teachers showed statistically significant gains compared to control teachers on End-of-Course tests.

To properly estimate the impact of the program, four different sub-samples were analyzed: mathematics-EOC, science-EOC, mathematics -MAP and science-MAP. The analyses were performed for the different grades (as adequate n's permitted) and also for all grades together.

Broadly speaking, the main findings showed that the ITQG program in Cycle 9 was effective in statistical terms at the high school level (EOC tests) and ineffective at the Elementary Level (MAP tests). In other words, students of ITQG elementary teachers did not show statistically significant differences when compared to students of non-participating teachers. However, high school students taught by ITQG teachers **did** evidence positive, statistically significant results when compared to students of non-ITQG teachers.

It is important to note that these results do not suggest that elementary/middle school students did not benefit from their teachers' participation in the ITQG. Rather, the evaluators believe that the results in part reflect the nature of the MAP tests, and that gains seen simply did not reach the rigorously stringent standard of statistical significance.

At the same time, that such significant differences were found with high school students through EOC data analyses indicates both that the tests are more directly relevant to the content taught, and that the results were noteworthy. Despite questions related to sample sizes and limited power stemming from smaller numbers of ITQG high school students for whom data were available, the finding of statistically significant, positive differences strongly indicates that the ITQG teacher professional development produced a rapid, measurable impact at the high school level.

6. ITQG's Institutional Impact

The Improving Teacher Quality Program represents a partnership model of professional development. The university-based science and math content faculty and educators guiding the projects in Cycle 9 – across all seven projects – bring considerable experience in working with school districts in their regions and beyond. Projects largely are based on earlier iterations of professional development programs conducted by the teams, somewhat modified to include ITQG-specific components in varying degrees of intensity. The project teams are familiar with their constituent school districts, having worked with them over long periods of time. They also are knowledgeable about the practical challenges in their own institutions' teacher preparations programs.

The capacity of the ITQG projects to sustain their efforts post-funding or to effect institutional change either at the university or school district level is practically limited. The overwhelming focus of energy is given to working with teachers on their needs. Nevertheless, several examples may be cited as models for how institutionalization of ITQG's work can be approached. Also, network analysis of teacher support patterns offers suggestive indications of how project dynamics may affect the post-ITQG experience.

Enhancing Preservice Teacher Programs and Other Education Institutionalization

Three projects especially noted changes in preservice teacher courses that suggested enhancement in terms of integrating relevant resources and ITQG-supported pedagogy. The projects' own descriptions are:

- The science education instructor reports adding new aspects to her science methods courses, including having preservice teachers participate in open inquiry, having them "unpack" the GLEs, and using content learned in the <project> workshops. She has identified clear goals to structure expectations more effectively with inquiry work, modeling more science lessons and using <project> essential questions.

- Two members of the project personnel team teach methods and/or content courses for middle and high school pre-service mathematics teachers and each has reported incorporating activities, case studies, classroom examples, other instructional materials, and discussions surrounding inquiry as an effective instructional strategy developed for and during this project into their courses. In classes for pre-service teachers, grant personnel have taken advantage of repeated opportunities to share school classroom examples (from project participants) and teacher strategies/difficulties that address the following teaching, learning and assessment topics: increased understanding of the criterion and usefulness of depth of knowledge when constructing and evaluating higher-order Map-like assessment items; basic strategies for dealing with student misconceptions, using formative assessment probes and anticipation guides; considering and evaluating both national and statewide mathematics standards and how they apply to Missouri's everchanging CLEs and core content; use of calculator-based real-time data collection probes and both calculator- and computer-based statistics and probability.

- A partnership has been established between a participating <project> school and <university> to enable preservice elementary teachers to complete their junior field experience (concurrent with the science methods course) to enable them to view and participate in <project> teachers' classrooms. This will enable greater consistency between what preservice teachers are learning at the university and what they are seeing in classrooms.

An additional example of institutionalization is the manner in which the science content faculty in one project – representing the largest group of content faculty members in any project – have committed to increasing application of inquiry-based methods in their own classrooms as they find appropriate. The contrast between pre-university and university-level science and math course pedagogical practice has often been cited as an example of how, especially at the high school level, inquiry must yield to a more traditional lecture-based method in order to prepare students for what they will encounter in higher education. This project's faculty seeks actively to achieve a practical balance that does not simply dismiss the potential efficacy of inquiry and related methods to their students.

Maintaining Effective Learning Networks

One element of sustaining the ITQG project's efforts is enhancing the professional networks teachers can rely on to share information and resources, seek and find support, and otherwise build on their capacity as teachers. Many teachers, especially in rural areas, are limited in the number of peer colleagues, and strengthening support networks.

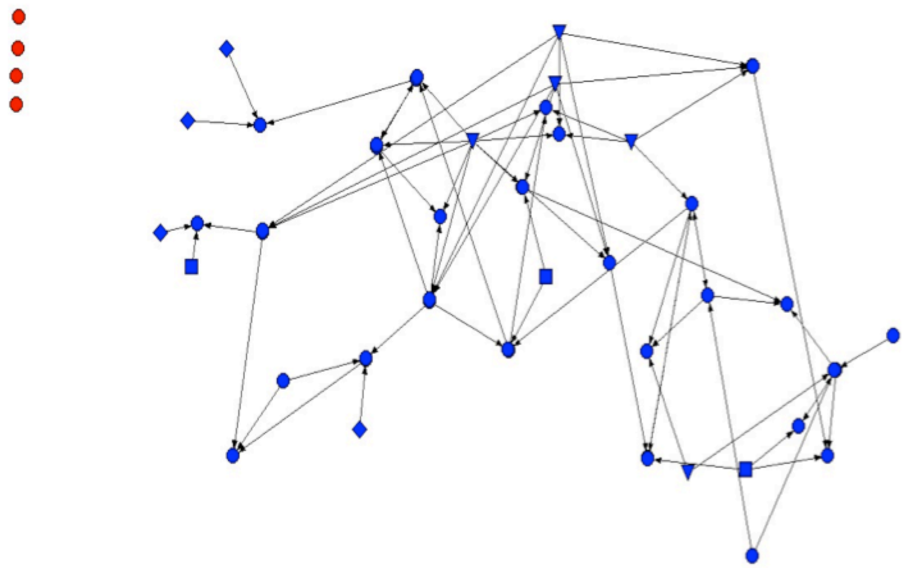
Social network analysis permits viewing where teachers go for information, and who comes to them. Figure 12 shows a typical example of what is being seen with ITQG projects for content, and Figure 13 shows pedagogy. Faculty Leadership team and staff (▼) most frequently serve as ad hoc centers of content and pedagogical support for teachers (●), usually with the project director representing the major content. At the same time, existing networks continue.

Removal of project leadership team and staff from the mix demonstrates the relative isolation of many teachers. Some reported no go-to source for content and pedagogical support. While this does not mean they do not in fact have people to whom they turn, or come to them for assistance, no one came to their minds as a major or frequent source of such assistance. Their apparent isolation within the projects also is evident. At the same time, the results of deleting the faculty connections from the network shows to what extent existing sub-networks often rely on a single point of contact to larger pools of potential support.

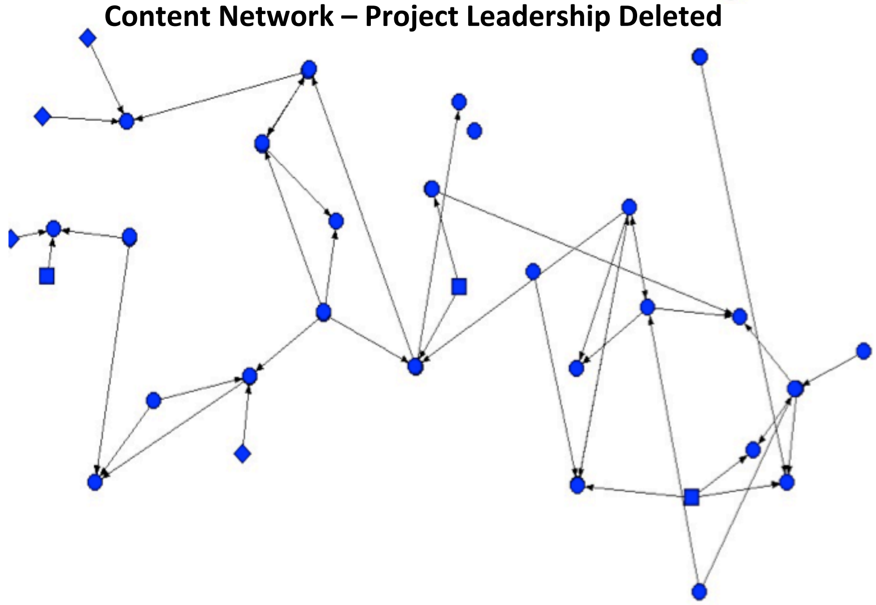
A consideration of teachers who "go to each other" indicates the strongest core support relationships; these often are colleagues at their school. In small schools no potential for comparable routine exchanges exist.

Figure 12. Representative ITQG Cycle 9 Project Social Networks for Content Support, with Project Leadership Role Included and Deleted

Content Network - Total



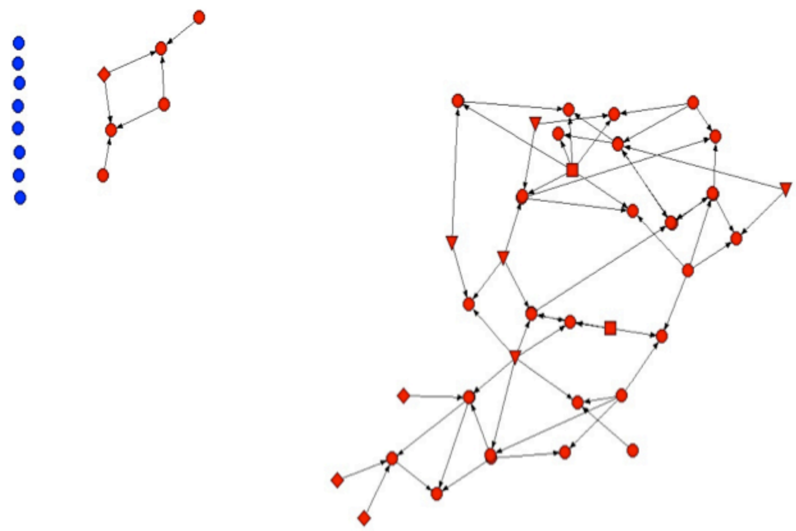
Content Network – Project Leadership Deleted



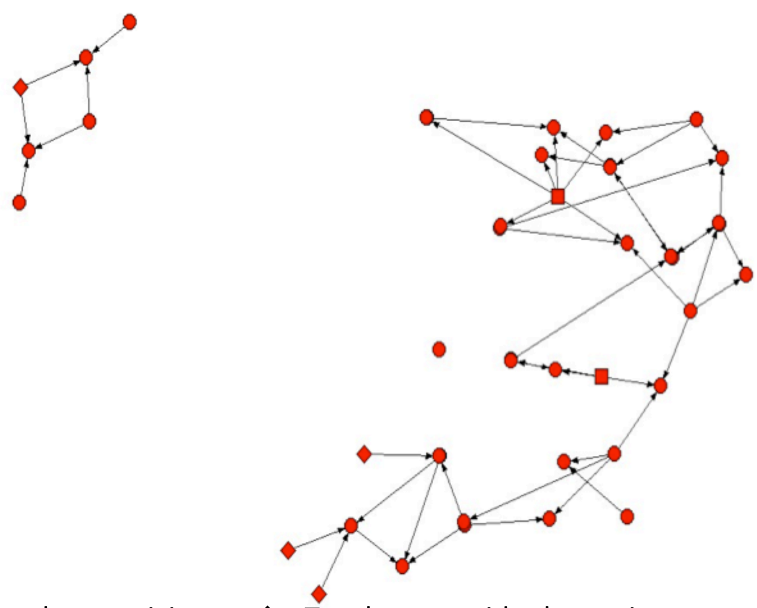
▲ - Project faculty ● - Teacher participants ◆ - Teachers outside the project
✚ - Graduate student ■ - School/district administrator ▼ - Project Leadership
Arrows indicate whether assistance is being sought by or from the person represented. Circles to left are teachers not reporting either seeking support or having others seek support of them.

Figure 13. Representative ITQG Cycle 9 Project Social Networks for Pedagogy Support, with Project Leadership Role Included and Deleted

Pedagogy Network - Total



Pedagogy Network – Project Leadership Deleted



▲ - Project faculty ● - Teacher participants ◆ - Teachers outside the project
✚ - Graduate student ■ - School/district administrator ▼ - Project Leadership
Arrows indicate whether assistance is being sought by or from the person represented. Circles to left are teachers not reporting either seeking support or having others seek support of them.

7. Evaluation Comments and Recommendations

The Improving Teacher Quality Grant Program in Cycle 9 represents an established source of teacher professional development in Missouri that many teachers, schools and school districts have come to rely on to augment in-district efforts to maintain quality math and science curricular programs. Participating schools and districts largely represent high-need areas, where challenges exist in achieving desirable standards of achievement. A commitment to reach as much of the state as possible helps ensure that many rural areas, not usually a focus of such professional development, are included. Cycle 9, which reaches most parts of Missouri in its seven projects, demonstrates the relative success of meeting this aim.

Across the program, project teams are qualified, experienced professional developers who understand the needs of participating teachers and, with a few exceptions, the full range of expectations that come with ITQG project funding. With extremely variable support at institutions of higher education for their faculty undertaking such complex educational projects, the motivations of the project directors and their teams are fully focused on the goal of assisting teachers to be better teachers. The extraneous rewards for this work are relatively limited, and the requirements for implementation in terms of coverage and logistics are substantial.

The projects, in various ways, all succeeded in Cycle 9. Participating teachers were overwhelmingly satisfied with their projects' curricula. The evaluators encountered no negative comments among administrators contacted, but heard of general support for their teachers' professional development efforts even in those cases when administrators did not recall the specifics of the program. All projects but one saw their teachers experiencing statistically significant gains in content, and the fact that the content was not focused specifically on the projects' own curriculum show that teachers were learning as much about how to think about science and mathematics as they were about particular content. These results align with the ITQG's pedagogical expectations.

Student analysis results offered strong indications that IQTG projects are reaching students through participating teachers, with a statistically significant impact at the high school level through End-of-Course test results immediately apparent. In other words, high school students whose teachers participated in the ITQG Program showed gains in content knowledge achievement greater than did the students of teachers who weren't in the program. Students at earlier grades, with analyses based on MAP test scores, a different dataset, did not show such results. However, the nature of the MAP tests, in the evaluators' view, could conflate outcomes in the types of analyses required.

To the evaluators' knowledge, this represents the first finding supporting the efficacy of the program in such an objective, stringently evaluated way. The linkage of institutions of higher education with school districts in a teacher professional development setting focusing on STEM content and pedagogy, including specific school district needs, can be seen to work and, in some cases, work rapidly.

Evaluative challenges largely focused on formative and process concerns. Some projects were slower to adapt to the updated evaluation models, and had become accustomed to a pattern of less direct engagement in ensuring alignment of implementation to ITQG expectations and to projects' action plans. The fact that the Missouri Department of Higher Education is seeking to integrate projects' results within a unified vision for the ITQG also presented some challenges, as some project teams also see their ITQG funding as a means to support their own pre-planned, ongoing professional development efforts.

With these comments in mind, the external evaluators offer the following recommendations for helping to ensure continued success in moving the ITQG forward – in implementation and in securing objective evidence of each project's impact.

Major Program Recommendations

- Project teams would best support the achievement of their objectives by ensuring that recommended pedagogical practice is consistently modeled, and that any guest presenters are cognizant of the ITQG project's goals and pedagogy aims.
- Project teams must continue to enhance their internal evaluation plans; prepare responsible, validated and reliable pre/post teacher tests; develop objective measures for tracking student achievement effects; and designate responsible, experienced personnel to secure the best results from internal evaluation efforts.
- Projects also should maintain standard protocols for project implementation, such as documentation, appropriate sign-ins and other record-keeping for participants being paid stipends (teachers themselves must sign in and out; project tallies have been seen to be inaccurate), explanations for changes in activity plans, and communication with the Missouri Department of Higher Education when changes in personnel, partner districts, and other project details occur.
- While the funding of multi-year projects is laudable, a process to assess each project's experience and results prior to formally inviting the project to continue in the following cycle would assist in ensuring that the limited funding is expended in the best possible way for Missouri.
- For project teams previously funded by the ITQG, care must be applied to avoid repetition in curriculum or a tendency to serve the same teachers as in past implementations with the same curriculum.
- Multi-year projects would be served by developing retention strategies to ensure that the best teacher retention results are secured, and that if new teachers enter the project in a second or third year their project experience does not suffer from partial intervention.
- Use support staff such as GRAs/TAs in an integrated, consistent fashion that ensures their presence and support in the project where needed.

- Additional staff resources at the Missouri Department of Elementary and Secondary Education would permit an expansion of the agency's data collection and quality control system and processes. With so much emphasis placed on the results of testing, the completeness and accuracy of these data are more important than ever. Recognizing that funding for staffing is dependent on the state's budget process, the evaluators strongly urge those responsible to provide the agency with the funds required to support the existing professionals on the staff and expand the data system's capacity.